



## Mars Express – butterfly ejecta and wrinkle ridges in Melas Dorsa

05 July 2012

On 17 April 2012, the High Resolution Stereo Camera (HRSC) operated by the German Aerospace Center (Deutsches Zentrum für Luft- und Raumfahrt; DLR) on board ESA's Mars Express spacecraft acquired images of a region in Melas Dorsa.

Melas Dorsa is located in the volcanic highlands of Mars between Sinai and Thaumasia Plana, about 250 kilometres south of Melas Chasma, which is the central part of the large Valles Marineris canyon system. A large, oval crater measuring about 16 kilometres across is immediately apparent in this image, with its ejecta blanket taking the shape of a butterfly. To form such an ejecta blanket, the impact must have occurred at a very shallow angle with respect to the planet's surface; it is thought that subsurface ice was present, and that this liquefied or vaporised on impact.

Ridge-like structures resembling twisted rope extend across the image. These terrain features are known as 'wrinkle ridges'. Although volcanic in origin, wrinkle ridges are tectonic terrain forms. They arise in volcanically deposited rock layers that form out of a single hardened lava flow. During the cooling process, the lava contracts and strong compressive forces are generated. The pressure causes areas of rock to shrink – and the corresponding reduction in surface area causes these characteristic wrinkles to form.

Another interesting tectonic phenomenon can be seen in the left half of the full image. After the formation of the wrinkle ridges, further displacements occurred in the crust, which caused several faults to arise. Arranged in a receding sequence, these stress faults run across almost the full height of the image. Formations of this kind are also found on Earth, and are referred to as 'en echelon' displacements or step faults.

Another striking feature is the filled crater in the upper part of the image. This shows evidence of concentric deposits, which could provide insights into the material properties of the filling.

### **Image processing and the HRSC experiment on Mars Express**

These HRSC images were acquired during Mars Express orbit 10,532. The image resolution is approximately 18 metres per pixel. The data was acquired at approximately 18 degrees south and 288 degrees east.

The plan-view colour image was created from the nadir channel, the field of view of which is aligned perpendicular to the surface of Mars, and the colour channels; the oblique perspective view was generated from HRSC stereo channel data. The anaglyph, which creates a three-dimensional impression of the landscape when viewed with red/blue or red/green glasses, was derived from the nadir channel and one stereo channel. The colour-coded plan view is based on a digital terrain model of the region, from which the topography of the landscape can be derived.

The HRSC camera experiment on board the European Space Agency's Mars Express mission is headed by Principal Investigator (PI) Professor Gerhard Neukum (Freie Universität Berlin), who was also responsible for the technical design of the camera. The science team consists of 40 co-investigators from 33 institutions in 10 nations. The camera was developed at DLR under the leadership of the PI and it was built in cooperation with industrial partners EADS Astrium, Lewicki Microelectronic GmbH and Jena-Optronik GmbH. The instrument is operated by the DLR Institute of Planetary Research in Berlin-Adlershof. The systematic processing of the

## Contacts

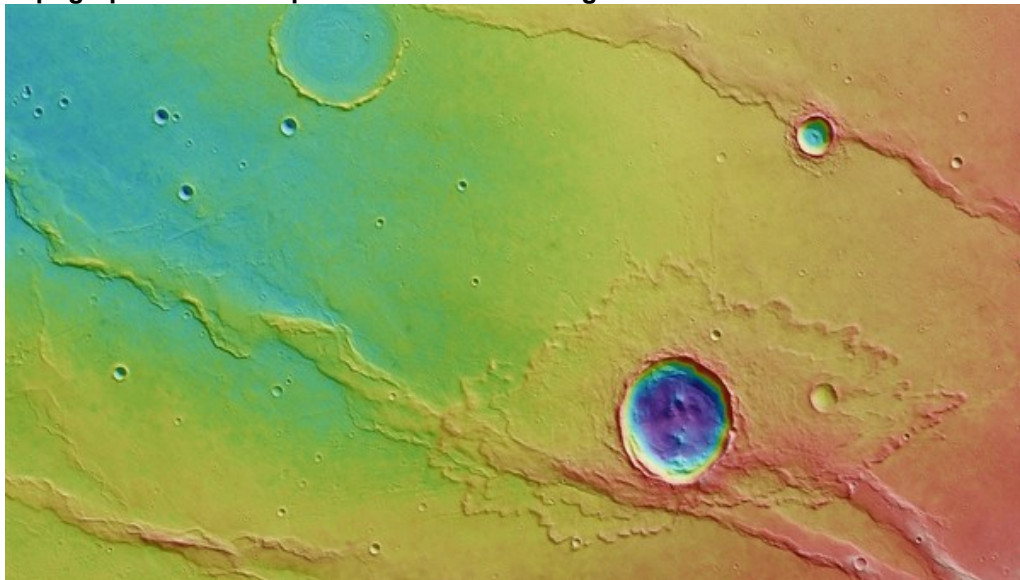
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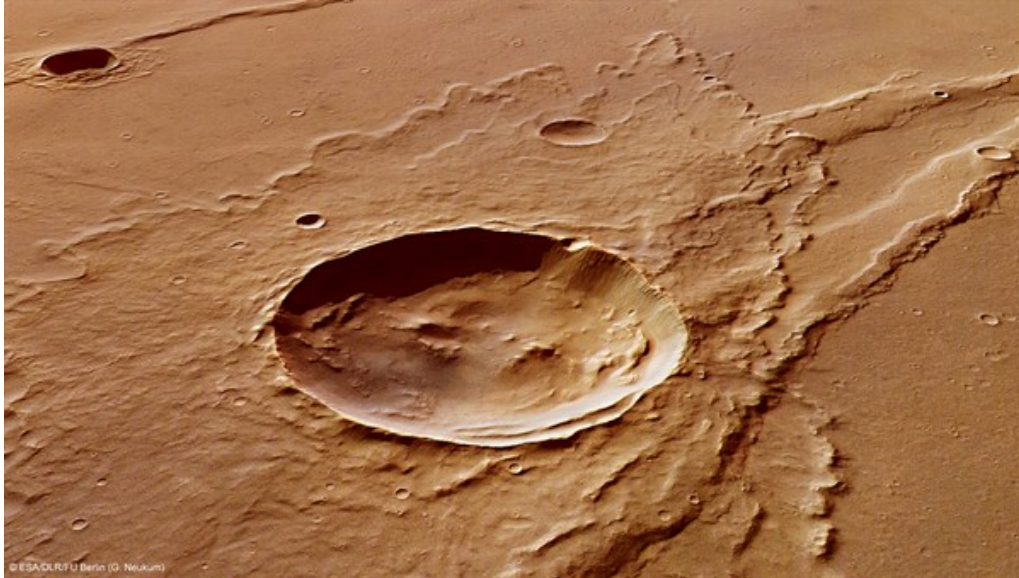
## Topographic HRSC map of the Melas Dorsa region



Using the High Resolution Stereo Camera (HRSC), digital terrain models can be derived that illustrate the topography of the region using false colours. The altitudes can be read from the coloured scale at the top right of the full image. In the absence of 'sea level', the elevation data is referenced to an areoid – a modelled equipotential surface on which everything experiences the same gravitational attraction towards the centre of the planet. The wrinkle ridges and the 16-kilometre crater with butterfly-shaped ejecta are all clearly discernible. Copyright note: As a joint undertaking by DLR, ESA and FU Berlin, the Mars Express HRSC images are published under a Creative Commons licence since December 2014: ESA/DLR/FU Berlin, CC BY-SA 3.0 IGO. This licence will also apply to all HRSC images released to date.

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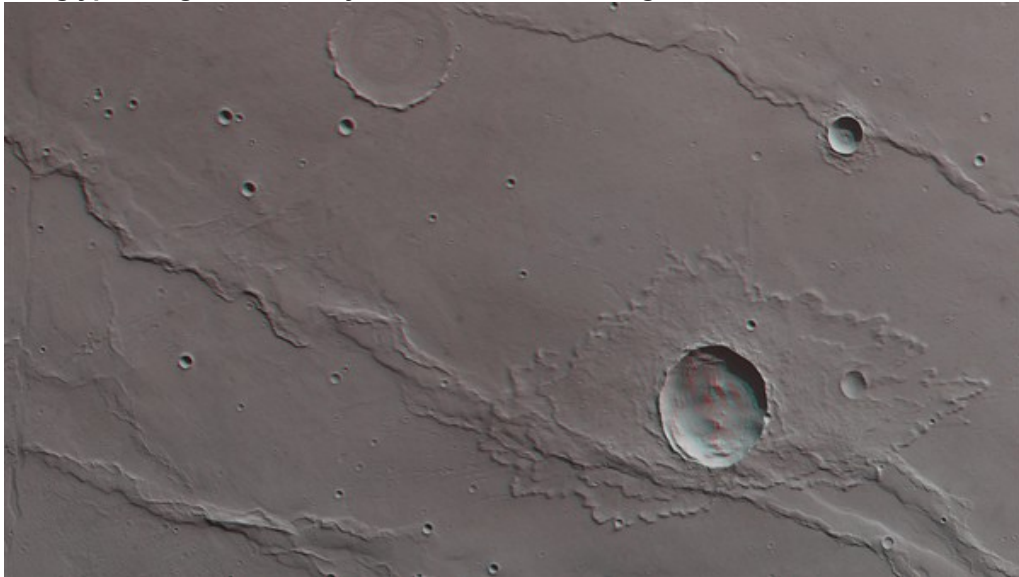
### Perspective view of a crater with butterfly-shaped ejecta



Realistic perspective views of the surface of Mars can be generated from data acquired by the stereo and colour channels of the High Resolution Stereo Camera (HRSC) on board ESA's Mars Express spacecraft, which are oriented at an oblique angle with respect to the planet's surface. This image shows a view into a crater with butterfly-shaped ejecta located in the Melas Dorsa region. To form an ejecta blanket of this shape, the impact must have occurred at a very shallow angle to the planet's surface; it is thought that subsurface ice was present, and that this liquefied or vaporised on impact. Copyright note: As a joint undertaking by DLR, ESA and FU Berlin, the Mars Express HRSC images are published under a Creative Commons licence since December 2014: ESA/DLR/FU Berlin, CC BY-SA 3.0 IGO. This licence will also apply to all HRSC images released to date.

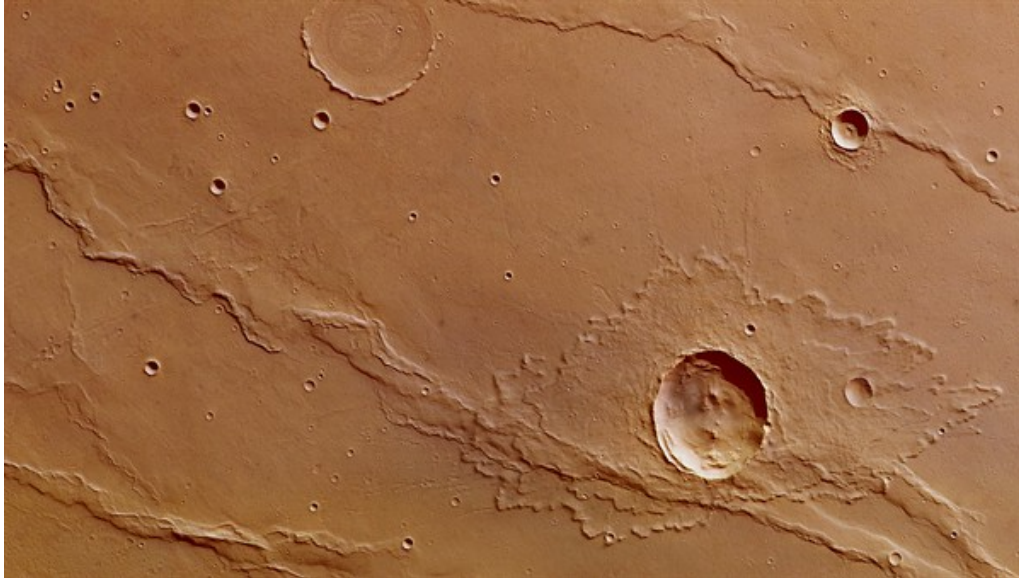
Credit: ESA/DLR/FU Berlin, CC BY-SA 3.0 IGO.

### Anaglyph image of 'butterfly' crater and wrinkle ridges



Anaglyph images can be created from the nadir channel of the High Resolution Stereo Camera (HRSC) camera system, which looks vertically down at Mars, and one of the four stereo channels, which are directed obliquely towards the surface. Using red/blue (cyan) or red/green glasses gives a three-dimensional impression of the landscape. This image shows a slightly oval crater about 16 kilometres across, with an ejecta blanket in the shape of a butterfly. Ridge-like structures resembling twisted rope can also be seen running across the image. These terrain features are known as 'wrinkle ridges'. Copyright note: As a joint undertaking by DLR, ESA and FU Berlin, the Mars Express HRSC images are published under a Creative Commons licence since December 2014: ESA/DLR/FU Berlin, CC BY-SA 3.0 IGO. This licence will also apply to all HRSC images released to date.

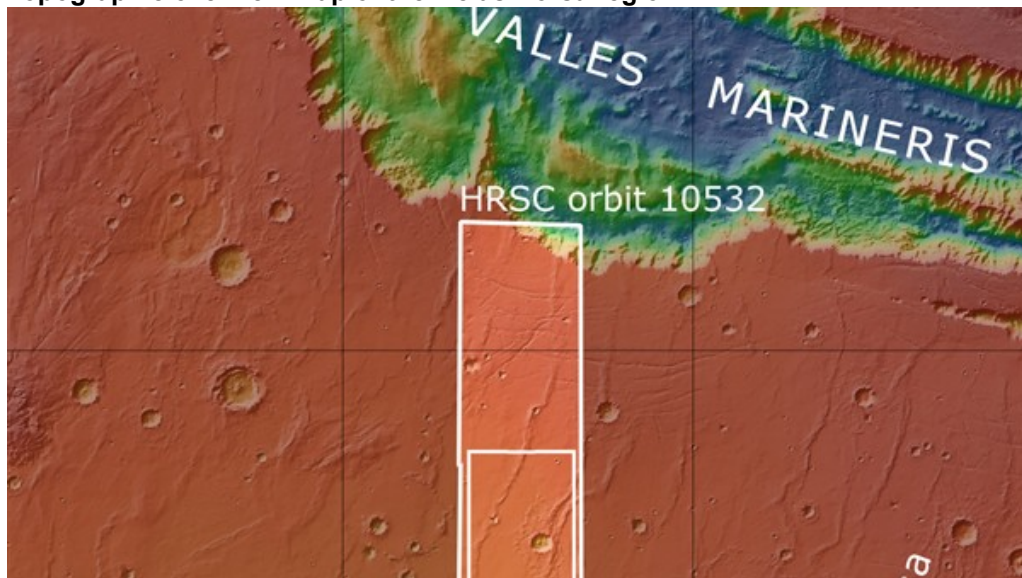
### Colour plan view of the Melas Dorsa region in the Martian Highlands



This colour plan view was created by combining data from the nadir channel of the High Resolution Stereo Camera (HRSC) on board ESA's Mars Express spacecraft, which is directed vertically down onto the planet's surface, with data from the colour channels. Melas Dorsa is located in the volcanic highlands of Mars between Sinai and Thaumasia Plana, about 250 kilometres south of Melas Chasma, the central part of the large Valles Marineris canyon system. A crater with butterfly-shaped ejecta is a visually striking feature, as are what are referred to as 'wrinkle ridges' – ridge-like structures running diagonally across the image and resembling twisted ropes. These arise in volcanically deposited rock layers that form out of a single hardened lava flow. During the cooling process, the lava contracts and strong compressive forces are generated. This pressure causes areas of rock to shrink, causing these characteristic wrinkles to form. Copyright note: As a joint undertaking by DLR, ESA and FU Berlin, the Mars Express HRSC images are published under a Creative Commons licence since December 2014: ESA/DLR/FU Berlin, CC BY-SA 3.0 IGO. This licence will also apply to all HRSC images released to date.

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### Topographic overview map of the Melas Dorsa region



Melas Dorsa is located in the volcanic highlands of Mars between Sinai and Thaumasia Plana, about 250 kilometres South of Melas Chasma, the central part of the large Valles Marineris canyon system. On 17 April 2012, the High Resolution Stereo Camera (HRSC) on board ESA's

Mars Express spacecraft acquired images of part of this region during orbit 10,532. The features depicted in the other images presented here are located in the small, inner rectangle.

Credit: NASA/JPL (MOLA); FU Berlin.

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